

01534149

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

**(19) World Intellectual Property Organization
International Bureau**



~~PROVISIONS OF THE TREATY~~ PROVISIONS OF THE TREATY

Y 2005

**(43) International Publication Date
27 May 2004 (27.05.2004)**

PCT

(10) International Publication Number
WO 2004/044615 A3

(51) International Patent Classification⁷: G01V 1/28

27 May 2004 (27.05.2004)

(21) International Application Number: PCT/US2003/036219

(22) International Filing Date: 10 November 2003 (10.11.2003)

(25) Filing Language: English

(26) Publication Language: English

60/424,937 9 November 2002 (09.11.2002) US

(72) Inventors; and
(75) Inventors/Applicants (*for US only*): COHEN, Israel
[IL/IL]; 17 Lea Street, 34403 Haifa (IL) VASSILIOU

Anthony [GR/US]; GeoEnergy, Inc., 3000 Wilcrest Dr., Ste 241, Houston, TX 77042 (US). **COULT**, Nicholas [US/US]; 2521 Irving Ave S, Minneapolis, MN 55405 (US).

(74) Agent: **NICHOLS, Michael**; Law Office of Michael R. Nichols, PMB #155, 3001 S. Hardin Blvd., Ste 110, McKinney, TX 75070 (US).

(81) Designated State (*national*): US.

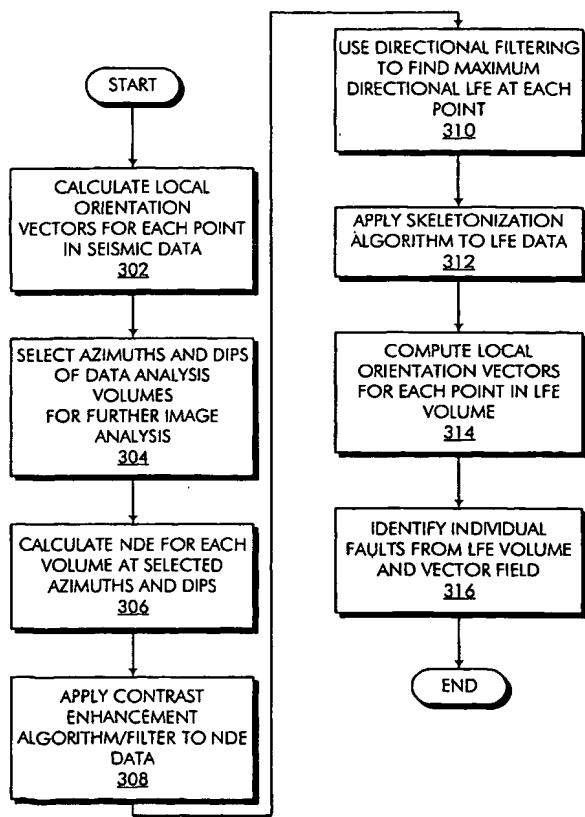
(84) Designated States (*regional*): European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR).

Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR)

[Continued on next page]

(54) Title: METHOD AND APPARATUS FOR SEISMIC FEATURE EXTRACTION



(57) Abstract: A method and apparatus for seismic image processing is disclosed. A preferred embodiment aids in the identification of subterranean faults, which are significant in hydrocarbon exploration. The method includes steps of: a) reading a three dimensional seismic data volume; b) computing the three-dimensional orientation of the subsurface; c) subdividing the original volume into small data volumes that are rotated at a predetermined set of dips and azimuths related to those of the subsurface orientation; d) computing a 3-D edge detection measure on the small volumes formed in step c; e) performing a 3-D contrast enhancement operation in each of the small volumes; f) filtering the result of the contrast enhancement with selected 3-D filters at the predetermined set of dips and azimuths; g) skeletonizing the results of the filtering operation; h) separating the individual fault surfaces, and i) labelling the individual fault surfaces for further interpretation and exploration.



- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designations European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR)
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designation US
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for the following designation US

- of inventorship (Rule 4.17(iv)) for US only

Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

(88) Date of publication of the international search report:

22 July 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

national Application No

PCT/US 03/36219

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01V1/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01V

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

EPO-Internal, COMPENDEX, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 02/03099 A (EXXONMOBIL UPSTREAM RES CO) 10 January 2002 (2002-01-10) page 7, line 5 - line 25 ---	1,30
A	HOCKER CHRISTIAN ET AL: "Fast structural interpretation with structure-oriented filtering" LEADING EDGE;LEADING EDGE (TULSA, OK) MARCH 2002, vol. 21, no. 3, March 2002 (2002-03), XP002280877 the whole document ---	1,30
A	US 2002/116131 A1 (MEEK ROBERT A) 22 August 2002 (2002-08-22) paragraphs '0017!-'0020! ---	1,30 -/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

& document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 May 2004	17/06/2004
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Lorne, B

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/36219

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2001/047245 A1 (SCHWARTZBARD ALAN E ET AL) 29 November 2001 (2001-11-29) claim 1	1,30
A	US 5 930 730 A (KIRLIN R LYNN ET AL) 27 July 1999 (1999-07-27) abstract	1,30
A	US 5 563 949 A (FARMER STEVEN L ET AL) 8 October 1996 (1996-10-08) cited in the application claim 1	1,30
A	CARTER NICHOLLE ET AL: "Fault imaging using edge detection and coherency measures on Hibernia 3-D seismic data" LEADING EDGE;LEADING EDGE (TULSA, OK) JAN 2001 SOC OF EXPLORATION GEOPHYSICISTS, TULSA, OK, USA, vol. 20, no. 1, January 2001 (2001-01), XP002280878 the whole document	1,30

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 03/36219

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
WO 0203099	A	10-01-2002	AU	7149001 A	14-01-2002
			CA	2414631 A1	10-01-2002
			GB	2383636 A ,B	02-07-2003
			NO	20026170 A	17-02-2003
			WO	0203099 A2	10-01-2002
			US	2002007247 A1	17-01-2002
US 2002116131	A1	22-08-2002	WO	02052299 A2	04-07-2002
US 2001047245	A1	29-11-2001	AU	5330701 A	30-10-2001
			CA	2405577 A1	25-10-2001
			GB	2377021 A ,B	31-12-2002
			NO	20024970 A	12-12-2002
			WO	0179889 A1	25-10-2001
US 5930730	A	27-07-1999	US	5563949 A	08-10-1996
			AU	709621 B2	02-09-1999
			AU	7382996 A	28-04-1997
			CA	2204168 A1	10-04-1997
			CN	1166207 A	26-11-1997
			EP	0796442 A1	24-09-1997
			NO	971801 A	05-06-1997
			WO	9713166 A1	10-04-1997
			US	RE38229 E1	19-08-2003
			AU	696742 B2	17-09-1998
			AU	4133396 A	03-07-1996
			CA	2179901 A1	20-06-1996
			CN	1138902 A ,B	25-12-1996
			EG	20609 A	30-09-1999
			EP	0736185 A1	09-10-1996
			NO	962731 A	11-10-1996
			RU	2144683 C1	20-01-2000
			WO	9618915 A1	20-06-1996
			US	5838564 A	17-11-1998
			RU	2187130 C2	10-08-2002
US 5563949	A	08-10-1996	AU	696742 B2	17-09-1998
			AU	4133396 A	03-07-1996
			CA	2179901 A1	20-06-1996
			CN	1138902 A ,B	25-12-1996
			EG	20609 A	30-09-1999
			EP	0736185 A1	09-10-1996
			NO	962731 A	11-10-1996
			RU	2144683 C1	20-01-2000
			WO	9618915 A1	20-06-1996
			US	5930730 A	27-07-1999
			US	5838564 A	17-11-1998
			US	RE38229 E1	19-08-2003